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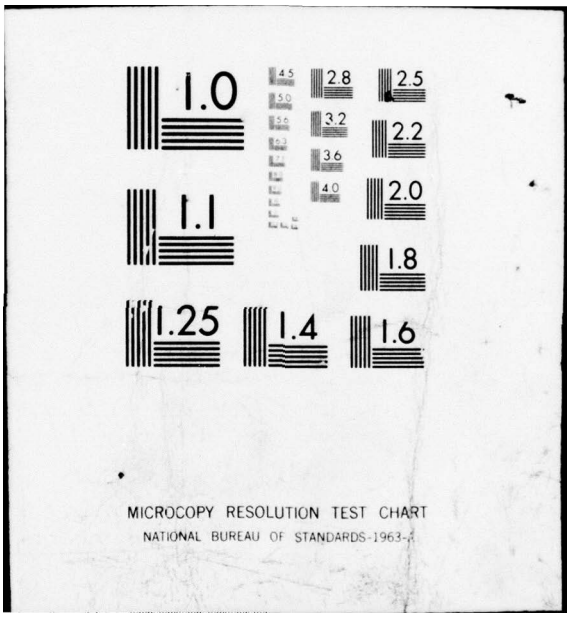
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EUROPEAN SCIENTIFIC NOTES

15 February 1951 Vol. 5, No. 4

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THE PHOTOELECTRIC DISINTEGRATION OF THE DEUTERON

The effective range of the neutron-proton force in the triplet stage has been determined by D. H. Wilkinson and collaborators of the Cavendish Laboratory, Cambridge University, in experiments on the photoelectric disintegration of the deuteron. A value of $1.76 \pm 0.09 \times 10^{-13}$ cm. is obtained for the range of this interaction, in good agreement with results which can be deduced from scattering measurements by Hughes, Burgy and Ringo, and by Melkonian.

The γ-rays used to disintegrate the deuterons were obtained by bombardment of various targets with protons from a Philips high-voltage set, and ranged in energy from 4.45 to 17.6 MeV. In this region of energies, the cross-section for the photoelectric disintegration is governed almost solely by the effective range of the neutron-proton force and is rather insensitive to the exact shape of the interaction potential. The experimental results were analyzed in terms of a "square well" and a "Yukawa" potential. In the analysis a small correction was applied for the photomagnetic disintegration cross-section, while quadrupole effects were so small as to be entirely negligible. The analysis was based on the commonly used 50-50 mixture of exchange and ordinary forces; a binding energy for the deuteron of 2.227 MeV was used. The disintegrations were produced in an ionization chamber containing deuterium at a pressure of 38 atmospheres. The pulses from the resulting protons were analyzed by a 99 channel kick-sorter. An identical chamber, filled with ordinary hydrogen, was used for estimating the various background effects. The measurements will be published in greater detail in the Proceedings of the Royal Society during the coming year.

INTERFERENCE MICROSCOPES

Several novel microscopes were described to the Optics Section of the Physical Society on February 1 by Dr. J. St. L. Philpot and Mr. J. Dyson. Dr. Philpot, who works in the Radiobiological Research Unit, Atomic Energy Research Establishment, Harwell, discussed a series of interference microscopes wherein the two beams are separated and rejoined by virtue of their differing states of polarization.

Double-Focus Lens Method

"Double focus" lenses are made of quartz whose optic axis lies in the plane of the lens so that the focal length will be different for the two states of polarization. One such lens is used below the condenser so that light of one state of polarization will illuminate the object and that of the other state of polarization will come to a focus above or below the object. He has found it convenient to make the quartz lenses in the form of cemented doublets having zero power for the ordinary ray and very slight power for the extraordinary ray. Such a lens can be inserted into the beam below a conventional condenser.

A similar lens is then put into the beam above the objective lens so that the two beams recombine in the focal plane. If the two beams are to interfere, they must be coherent, so it is necessary to illuminate the specimen through a polarizer oriented at 45° to the axes of the quartz lenses. The relative retardation of the two beams can be adjusted by means of a Soleil compensator in the illuminating system.

An experimental microscope has been built to Dr. Philpot's specifications by the firm of R. and J. Beck in London. It is now being tested. It is felt that the microscope has all of the advantages associated with ordinary phase microscopes but without the loss of light usually found and without the spurious halo frequently seen when a phase annulus is used. During the meeting it was revealed that a similar microscope has been developed independently at the firm of C. Baker in London.

Half-Silvered Mirror Method

Mr. J. Dyson of Associated Electrical Industries

Ltd. described two new interference microscopes which he has built. Both of these are of the type which use part silvered mirrors to separate and recombine the two beams which are to interfere. The first of these is shown in Fig. 1.

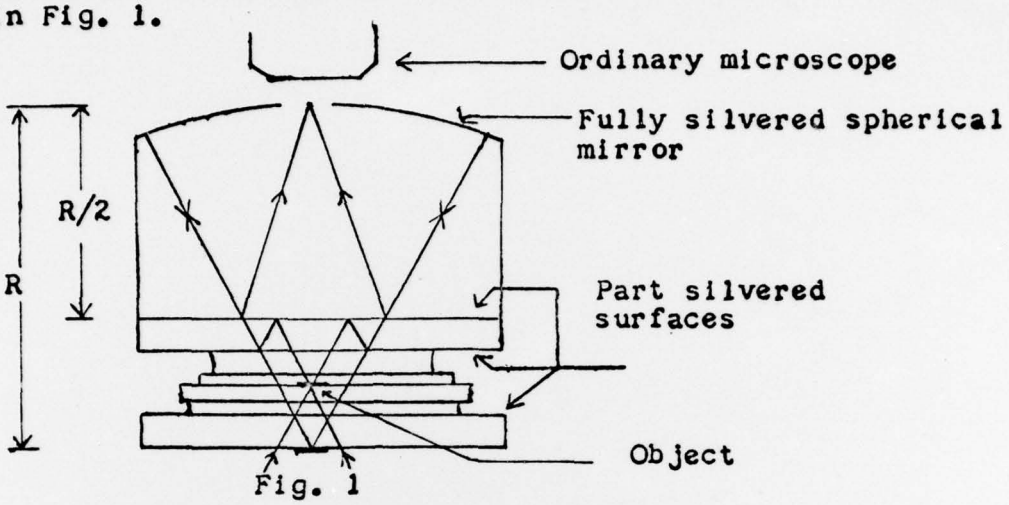

Fig. 1

The object in a suitable immersion fluid is in the center of the sandwich. Those rays which illuminate the object directly have to be reflected multiply to reach the image plane. There they meet and interfere with those rays that were reflected multiply below the object.

The bottom plate is made a very slight wedge so that the relative phase of the two beams can be adjusted by a small lateral movement. To compensate for this wedge, it is necessary to make the corresponding upper plate a similar wedge.

The loss of light in this system is very great even when the part silvered surfaces are correctly made.

For opaque objects Mr. Dyson has built another system shown in Fig. 2. The slight loss of symmetry necessary in this system leads to some spherical aberration. This is partly compensated by choosing an excessively thick "cover glass" at the top.

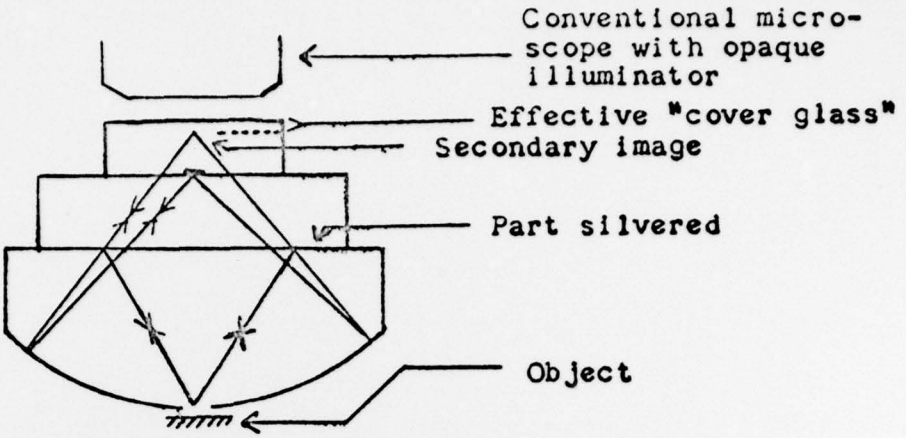

Fig. 2

The relative phase in this instrument is adjusted by moving the whole adaptor up and down a fraction of a micron. In order to do this with adequate delicacy Mr. Dyson has mounted the adaptor on a stiff spring and applies a very small force with an electro-magnet. The image stands still in spite of the movement of the adaptor.

Mr. R. Barber (University Museum, Oxford) showed some very interesting slides he had made to demonstrate that the performance of a phase microscope can often be improved by the addition of a single polarizer, thus converting even the slightest birefringence of the sample into a difference of phase.

THE THICKNESS OF THE HELIUM FILM

A report on the measurement of the thickness of helium films was presented recently before the Royal Society by Dr. L. C. Jackson and E. J. Burge of Bristol University. The technique and some of the results have been described in ESN 3, 167.

The complete data confirm and extend the preliminary results. The thickness at any given height above the liquid helium is nearly independent of the temperature between 1.1 and 2.18°K but decreases rapidly to zero at the λ point. The thickness at any given temperature varies, to a first approximation, as the inverse cube root of the height above the free liquid surface. This thickness-height relationship was found to hold to heights up to 7 cm. The thickness at a height of 1 cm and temperature of 1.5°K is 1.9×10^{-6} cm.

Experiments were also performed with heat input, using a small constantan heater on top of the mirror. With heat inputs up to 8 microwatts the film becomes thicker. As the heat input is increased beyond 8 microwatts, the film is at first driven off while at much higher heat inputs a new film appears. This new film is several orders of magnitude thicker than the old film was and is due to the fountain effect. There is thus a great difference between static and dynamic films.

The inverse cube root dependence of film thickness on height is predicted by the Frenkel-Schiff theory. This theory is based on a model in which the film is attracted to the surface by long range van der Waals forces. Thus, it does not predict an abrupt disappearance of the film at the λ point. For this reason, detailed experiments were performed with both increasing and decreasing temperatures around the λ point. These experiments conclusively showed a very sharp, reversible, change for the thickness of the film at the λ point. The puzzling nature of the sharp disappearance of the film at the λ point was emphasized in the discussion by Professor Mott, Dr. Mendelssohn and Dr. Temperley. Dr. Temperley stated that estimating the van der Waals forces from physical adsorption indicates that these forces cannot be strong enough to account for the adherence of films of the type observed.

SYNTHESIS OF SIMPLE PYRIMIDINES

Dr. J.F.W. McOmie of Bristol University is studying the synthesis of mono-substituted pyrimidines. Comparatively little is known about these compounds, which are much less accessible than polysubstituted pyrimidines. The simple derivatives should prove valuable as models to aid in the interpretation of the infrared and ultraviolet spectra of the more complex naturally occurring pyrimidines, such as Vitamin B_1, purines, pteridines, nucleic acids, etc.

A number of mono-substituted derivatives have been made. 4-Hydroxypyrimidine, prepared in 80 percent yield by Raney nickel desulfurization of 2-thiouracil, yields 4-chloropyrimidine hydrochloride on treatment with $POCl_3$. By use of conventional procedures, the chloro group may be replaced by the amino or mercapto group. 2,4-dichloropyrimidine obtained via the dihydroxy compound, on treatment with zinc dust yields the 2-chloro compound. It undergoes the same reactions as the 4-isomer.

It is of interest that when the chloropyrimidines mentioned above are refluxed in ethanol with thiourea, the mercapto derivatives are obtained directly in yield of 50-90 percent; in fact, no thiouronium salt could be isolated from the reaction.

5-Aminopyrimidine has also been prepared by another method. S-Methyl thiourea is condensed with nitromalonaldehyde to yield 5-nitro-2-methylmercapto pyrimidine. This compound on treatment with Raney nickel saturated with hydrogen, undergoes simultaneous reduction and de-sulfurization to the desired amino compound.

Dr. McOmie is also studying the synthesis of the simpler pteridines by methods which will leave no ambiguity as to their structure.

FAILURE OF NYLON CLIMBING ROPES

R. E. Meyer of the Department of Mathematics, University of Manchester, has made some preliminary theoretical investigations of the causes of failure in nylon climbing ropes. These ropes, although they are in general superior to manila ropes, have failed on a few occasions in a very curious way. Examination of the ropes after accidents during mountain climbing reveals that they seldom fail at the point where the strain is applied, for example, at the point where they are wedged in a crevice or belayed to a piton or chockstone, but rather they tend to part approximately two-thirds of the distance down the belay. Where it has been possible to recover the rope, it is generally found that the parted ends are brittle, indicating that considerable heat was generated there. It is probable that the intense local heating is due to complicated shock wave interactions.

Much more work needs to be done on the elastic-plastic properties of nylon before a detailed theory can be worked out. It is known, for example, that under static loading nylon shows an anomalous stress-strain behavior, such that the curve is concave upwards. When the nylon is loaded dynamically, however, the stress-strain relation depends to a marked degree on the rate of loading. The rather unusual elastic-plastic behavior of nylon is undoubtedly related to the polymer structure, and this aspect of the problem is now being investigated at Imperial Chemical Industries.

EXPOSED TREATMENT OF BURNS

A symposium on the mass treatment of burns was held on 10 February 1951 by the Section of United Services, Royal Society of Medicine, London. Colonel Edward J. Pulaski, who is in charge of the Experimental Surgical Unit of Brooke General Hospital, gave an account of burn patients treated by the exposure method at Brooke and Tokio Army Hospital. Although the patients were received at Tokio on an average of 4.5 days after injury, their dressings were removed and the burned areas were cleansed, debrided, exposed, and general measures employed, in the same manner as the Brooke cases who were received within a few hours following injury. Healing occurred at the same rate in both series in terms of days after starting exposure, not days after injury.

NEW GERMAN COSMIC RAY LABORATORY

A cosmic ray laboratory will be incorporated in the new radio transmitter under construction on the top of the Zugspitze (near Garmisch-Partenkirchen) for the German Federal Post. Professor W. Heisenberg (Göttingen) and Professor E. Regener (Stuttgart), acting for the German Research Council, have secured an appropriation of $125,000 from the German Federal Republic for the construction and equipment of the research tower. The laboratory site has an elevation of approximately 8,500 feet and is served by a suspension railway, which already is in operation. It should be ideal, therefore, for high altitude cloud chamber and photographic plate studies of cosmic ray particles.

DYNAMICS OF IONIZED MEDIA

A Conference on the Dynamics of Ionized Media will be held in the Physics Department at University College, London, from 19 to 21 March 1951. The conference is under the chairmanship of Professor H.S.W. Massey. The program includes discussions on magneto-hydrodynamics, plasma oscillations, and their cosmical applications. Following is a partial list of participants and the titles of the papers they will read:

Dynamo action	T. Gold (Cambridge)
Electric currents in very diffuse gases	F. Hoyle (Cambridge)

Plasmas in strong magnetic fields	H.S.W. Massey
The generation of plasma-oscillations in the absence of magnetic fields	K. G. Emeleus (Belfast)
The Bailey theory of plasma-oscillations	J. A. Roberts (Cambridge)
Oscillations in crossed fields in slipping streams of electrons	Representative from T.R.E. Malvern
General equations for the oscillations in electron streams and approximate equations for plasma oscillations	D. Gabor (London)
Magneto storms and aurorae	V.C.A. Ferraro (Exeter)
Do Plasma-oscillations contribute to cosmic radio noise?	T. Gold (Cambridge) M. Ryle (Cambridge)

PERSONAL NEWS ITEM

Professor Werner Heisenberg of the University of Göttingen has been appointed President of the newly created Forschungsrat (Research Council) of the German Federal Republic. The Council acts in an advisory capacity to the government on all matters relating to science and is also the official representative of Germany in its scientific foreign relations.

Prepared by the Scientific Staff
Submitted by Dr. M. E. Bell
Deputy Scientific Director

Philip D. Lohmann

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Captain, U.S.N.
Assistant Naval Attache for Research